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09/780,390	02/12/2001	Howard E. Rhodes	M4065.0111/P111-A	9416

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DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP  
2101 L STREET NW  
WASHINGTON, DC 20037-1526

EXAMINER
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MALSAWMA, LALRINFAMKIM HMAR

ART UNIT	PAPER NUMBER
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2825

DATE MAILED: 07/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/780,390

Applicant(s)

RHODES ET AL.

Examiner

Lex Malsawma

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 May 2003.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-87 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-87 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 April 2001 is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- |                                                                                              |                                                                             |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                             | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)         | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 8-10, 14, and 20-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

#### *Regarding Claim 8:*

This claim contains a limitation for a first doped region of [the] second conductivity type at least partially under the isolation region. However, Claim 1 has been amended to include a “third doped region” formed beneath the isolation region. It is not clear whether the “first” doped region of the instant claim is different from the “third” doped region in Claim 1, since there is no disclosure, within the current specification, of two separate doped regions beneath the isolation region, e.g., note in Fig. 3 of the current drawings, region “140” below the isolation region “120” would be the “third” doped region specified in Claim 1; accordingly, it would seem that the “first” doped region of the instant claim is the same region as the “third” doped region in Claim 1; therefore, Examiner interprets the first doped region of the instant claim to be the same region as the third doped region in Claim 1.

#### *Regarding Claims 9-10, 14, and 20-23:*

These claims are rejected as being indefinite because they depend from an indefinite claim (Claim 8). Any further rejections of, or indications of the allowability of, Claims 8-10, 14, or 20-23 are based on the Examiner’s interpretation of Claim 8.

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-3, 5-15, and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang (6,140,670) in view of Yiannoulos (5,942,775).

*Regarding Claims 1-3, 8-11, and 13:*

Chang discloses (in Figs. 2A-2C) a diode comprising:

an isolation region 204 formed in a substrate by LOCOS (col. 3, lines 10-15);

a first doped active layer 210 comprising a first conductivity type (n-type, doped with arsenic at a dose of about  $4.0 \times 10^{14}$ ) formed in said substrate, wherein said doped layer is spaced apart from said isolation region; and

a second doped active layer 200 of a second conductivity type (p-type ) in contact with said first doped active layer, the contact of a said first and second active layers forming a p-n junction.

Chang lacks a third/first doped region of the second conductivity type under the isolation region 204. Yiannoulos teaches (note Fig. 1) a diode structure, similar to that disclose by Chang, wherein Yiannoulos discloses doped regions 106 (p-type or n-type) formed under isolation regions 104 such that the doped regions 106 are spaced away from the edge of isolation regions 104. Note that Yiannoulos specifically discloses (in col. 4, lines 40-44) the doped regions 106 are not necessarily required (i.e., not required for the diode) but “are material to

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overall CMOS technology in the context of a specific example of a layout". It is also important to note that Chang does not disclose (or is not concerned with disclosing) all aspects of a completed device; therefore, it would have been obvious to one of ordinary skill in the art to modify Chang by incorporating a third/first doped region (as currently claimed) because such a doped region was/is commonly included in a complete, functional IC device (as shown/taught by Yiannoulos).

*Regarding Claims 5-7:*

Chang (in view of Yiannoulos) lacks specifying any particular range for a space between the first doped region 210 and the isolation region 204. It would have been obvious to one of ordinary skill in the art to modify Chang by specifying a range for said space (as in the instant claims) because Chang discloses the general conditions of the claimed invention and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

*Regarding Claim 12:*

Chang (in view of Yiannoulos) lacks specifying phosphorous as the dopant for the first doped active layer 210. It was very well known and common in the art to utilize phosphorous as an n-type dopant in the manufacture of semiconductor devices; therefore, it would have been an obvious matter of design choice for one of ordinary skill in the art to modify Chang by utilizing phosphorous instead of arsenic because both are very well known n-type dopants.

*Regarding Claim 14:*

Chang (in view of Yiannoulos) lacks specifying any particular dopant-dosage range for the first doped region, however, it is important to note that the general conditions of the claimed

invention are disclosed. Therefore, it would have been obvious to one of ordinary skill in the art to specify a range for dopant dosage (as in the current claim) because Chang (in view of Yiannoulos) discloses the general conditions of the claimed invention, and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

*Regarding Claim 15:*

Chang discloses the first doped active layer 210 is n-type and the second doped active layer 200 can be a p-well (note col. 3, lines 7-10).

*Regarding Claims 24-27:*

Chang discloses, “[i]n general, photodiode devices are used as imaging sensors in different types of equipment, for example, PC cameras and digital cameras” (note col. 1, lines 33-35). One of ordinary skill in the art would realize that such cameras would include a CCD imager array, a CMOS imager array, a memory array, and/or a logic array. Therefore, the instant claims are held obvious over Chang.

5. Claims 4, 16-23, and 28-87 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang (in view of Yiannoulos) as applied to Claim 1 above, and further in view of Sasaki (6,150,676).

*Regarding Claim 4:*

Chang (in view Yiannoulos) **lacks** the field oxide region being a shallow trench isolation (STI) region. Sasaki is **cited** to show that it would have been an obvious matter of design choice for one of ordinary skill in the art to modify Chang by utilizing STI regions instead of “LOCOS”

regions. Sasaki **teaches** a device including a photodiode, wherein "LOCOS" regions are specifically disclosed in the figures; however, Sasaki discloses (in col. 19, lines 10-15) that it would be a matter of design choice to replace the "LOCOS" regions with STI regions. Therefore, the instant claim is held as an obvious design choice modification of Chang (view of Yiannoulos).

*Regarding Claims 16-19:*

Chang (in view Yiannoulos) **lacks** a fourth doped active region at least partially within the first doped active layer. However, note that Chang does not disclose a completely formed device, i.e., Chang specifically discloses only the elements pertinent to the inventive aspect of locating a photodiode structure spaced apart from isolation regions in order to reduce leakage current. It is important to note that Chang's inventive aspect is essentially the inventive aspect of the current invention. Sasaki **teaches** (in Figs. 11-14) that a photodiode (i.e., a device similar to Chang's diode) can be formed having various structures. Note in Fig. 13, Sasaki discloses a diode structure comprising a doped active layer 63 (n-type) within a first doped active layer 53 (n-type), wherein the doped active layer 63 is spaced away from the edge of the first active layer 53. Sasaki further discloses that the doped active layer 63 can have a dopant concentration in the range of  $1 \times 10^{12}$  to  $1 \times 10^{16} \text{ cm}^{-3}$ , wherein one of ordinary skill in the art would realize that such a range in dopant concentration could be readily obtained with a dopant dose of  $1 \times 10^{12}$  to  $1 \times 10^{16}$  ions/cm<sup>2</sup>, since the concentration would be a function of a dopant-dosage range and a depth of implantation. It would have been an obvious matter of design choice for one of ordinary skill in the art to modify Chang (in view of Yiannoulos) by incorporating a third doped active layer within said first doped active layer because Sasaki teaches such a structure is just one of a

plurality of known structures for a diode structure (i.e., a photodiode structure as generalized by Chang).

*Regarding Claims 20-23:*

These claims are similar to Claims 16-19, which were addressed in detail above; therefore, these claims are held obvious over the cited reference with reasoning similar to those applied to Claims 16-19, i.e., it would have been an obvious matter of design choice to modify Chang (in view of Yiannoulos) because Sasaki discloses it was well known in the art to incorporate a doped active layer ("63" in Fig. 13 of Sasaki) within a first doped active layer "53" (Fig. 13).

*Regarding Claim 28:*

This claim is similar to Claim 16; therefore, it is held obvious over the cited references with reasoning similar to that applied to Claims 1 and 16-19 above. Note that Sasaki discloses (in Fig. 13) the doped region "63" (i.e., the second doped active layer) is doped to a higher dopant dose than the first doped active layer "53"; and Sasaki discloses the first and second active layers (53, 63) and the substrate "62" form a p-n junction. Further note that Yiannoulos discloses it is common in the art to form a doped region "106" proximate to a lower boundary of an isolation region "104 (note Fig. 1 and col. 4, lines 40-44).

*Regarding Claims 29-31, 38-43, and 45:*

Chang (in view of Sasaki) disclose, or render obvious, all limitations within these claims. Note that all limitations within these claims have been specifically addressed above.



*Regarding Claims 32-34:*

These claims are similar to Claims 5-7, which were addressed in detail above; therefore, these claims are held obvious over the cited references with reasoning similar to that applied to Claims 5-7 above.

*Regarding Claims 35-37, 44, 58, 60, 64, 75-77, and 84:*

These claims contain limitations similar to those in Claims 8-10 and 14, which were addressed in detail above; therefore, these claims are held obvious over the cited references with reasoning similar to that applied to Claims 8-10 and 14 above.

*Regarding Claims 46-49:*

These claims are similar to Claims 24-27, which were addressed in detail above; therefore, these claims are held obvious over the cited references with reasoning similar to that applied to Claims 24-27 above.

*Regarding Claims 50-54, 61, 65, 66:*

All limitations in these claims have been specifically address above in the various combinations of the cited references. Specifically regarding Claim 50: Note that Chang discloses (col. 1, lines 33-35) that photodiodes are generally used in imaging sensors in equipment such as PC cameras and digital cameras, wherein such equipment would include a processor. Therefore, these claims are held obvious over the cited references, since all limitations are disclosed, or rendered obvious, by the cited references.

*Regarding Claims 55-57:*

These claims contain limitations similar to those in Claims 5-7, which were addressed in detail above; therefore, these claims are held obvious over the cited references with reasoning similar to that applied to Claims 5-7 above.

*Regarding Claim 59:*

This claim contains essentially the same limitation found in lines 6-7 of Claim 50, therefore, it is held obvious over the cited references.

*Regarding Claims 62, 63, 67-71, 78-83, and 85-87:*

All limitations in these claims have been specifically address above in the various combinations of the cited references. Specifically regarding Claim 67: Note that Chang discloses (col. 1, lines 33-35) that photodiodes are generally used in imaging sensors in equipment such as PC cameras and digital cameras, wherein such equipment would include an imaging device coupled to a processor. Therefore, these claims are held obvious over the cited references, since all limitations are disclosed, or rendered obvious, by the cited references.

*Regarding Claims 72-74:*

These claims contain limitations similar to those in Claims 5-7, which were addressed in detail above; therefore, these claims are held obvious over the cited references with reasoning similar to that applied to Claims 5-7 above.

***Remarks***

6. Applicants' remarks/arguments have been carefully reviewed and considered, but they are not persuasive. In general, Applicants' submit that the combination of references (Chang,

Yiannoulos, and Sasaki) cannot render obvious primarily the limitation, “a third doped region formed in said second doped active layer beneath said isolation region”, in combination with the other limitations recited in independent Claims 1, 28, 50, and 67. It is important to note that the primary reference, Chang, does not disclose all features of a complete, functional device, but rather, Chang is only concerned with disclosing features directed to the inventive aspect of the invention. Chang defines a problem associated with conventional photodiodes (note col. 2, lines 10-20) and discloses a remedy for the problems, wherein the remedy includes positioning a doped active layer spaced-apart from isolation regions. Chang does not disclose, or is not concerned with disclosing, details of elements/features that must be included in order to acquire a functional device, e.g., details regarding electrode/contacts to the diode structure, transistors integrated with the diode structure, etc.. Given Chang, alone or at least in combination with Yiannoulos and Sasaki, one of ordinary skill in the art would have clearly realized that Chang’s structure must be integrated with other devices (e.g., transistors) in order to acquire a completed functional device; and with the realization being made, one would have readily recognized that it would be typical in the art to form a doped region beneath the isolation region “104” (of Chang), especially since Yiannoulos specifically discloses that such a doped region would be typically incorporated into an integrated circuit (IC) comprising a photodiode structure similar to that disclosed by Chang (note again, Yiannoulos, col. 4, lines 10-44).

In summary, all pending claims are held obvious over the cited references because Chang discloses the general inventive aspect of the current invention, i.e., a diode structure having a doped active region spaced-apart from isolation regions; and given Yiannoulos and Sasaki, the features of the current inventions, which Applicants consider to be patentable over Chang, are

considered to be typical features that one would incorporate with Chang's device in order to acquire a functional IC device comprising a photodiode.

***Conclusion***

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 703-306-5986.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 703-308-1323. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Lex Malsawma



July 1, 2003



MATTHEW SMITH  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800